Was Leibniz the First Spacetime Structuralist?

Abstract

I argue that the standard interpretation of Leibniz as a relationist about space is mistaken, and defend a reading according to which his correspondence with Samuel Clarke actually suggests that Leibniz holds a view closely resembling modern spacetime structuralism. I distinguish my proposal from Belot's recent reading of Leibniz as a *modal* relationist, arguing for the superiority of my reading based on the Clarke correspondence and on Leibniz's conception of God's relation to the created world. I note a tension between my proposal and Leibniz's ontology, and suggest that a solution is forthcoming and worth pursuing.

1. Introduction. The canonical reading of Leibniz's view of space and time holds that he was a thoroughgoing *relationist*: roughly, he believed that there is nothing to space over and above the various relations of coexistence between bodies, and he believed that there is nothing to time over and above the relations of succession between events. This reading dates back to Russell and is perhaps recapitulated most fully in Earman's *World Enough and Spacetime* (1989); recently, Gordon Belot has suggested a more nuanced variant of it. Importantly, the received view relies very heavily on a correspondence between Leibniz and Samuel Clarke, in which Leibniz seems to argue transparently and at great length for the relationist conception of space that has long been attributed to him. I believe that this reading reveals a misunderstanding of what Leibniz says about space in the *Correspondence*. My goal in this paper, accordingly, will be to reconstruct in a somewhat schematic way what Leibniz's remarks therein actually tell us about his theory of space.

In a nutshell, I believe that his actual view looks suspiciously like a modern view known as *spacetime structuralism*, and my investigation will revolve around the claim that a plausible reconstruction of his view of space indicates that he was, for all intents and purposes, a proto- spacetime structuralist. In other words, Leibniz held a view of space very similar to that held by the modern spacetime structuralist, though he formulated it in different terms and based it upon his own particular metaphysics. I will proceed in the following manner, then: I'll first situate the canonical reading of Leibniz in light of a quick reconstruction of the main tenets of Newtonian substantivalism. Next, I'll introduce and explain spacetime structuralism, providing background for my discussion of Leibniz's views.

After this, I'll launch the promised investigation of Leibniz's view of space as he presents it against Clarke. In the course of the investigation, I'll distinguish my reading of Leibniz from Belot's and motivate a rejection of Belot's reading in favor of mine. At the very least, I hope to show how the machinery of spacetime structuralism enhances our understanding of Leibniz's view. But what I really want to establish is that Leibniz was, in a sense, the first spacetime structuralist: the lineage of this hotly debated view goes back much further than one would have thought.

2. Newtonian Substantivalism and Spacetime Structuralism. Let's now examine Newton's view of space. In the first Scholium of the *Principia*, Newton provides perhaps his most concise statement of what has come to be known as "substantivalism", saying that "absolute space, of its own nature and without reference to anything external, always remains homogeneous and immovable", and that "place is that part of space that a body occupies" (2004, 64-65). Space, in other words, exists over and above bodies; it's a preexisting "container" that would still be there even if there were no bodies. It is, in Earman's words, "a substratum of points underlying physical events" (1989, 10). Space and its parts "maintain their own identities independently of physical bodies", to quote a recent paper by John Roberts (2003, 555). The essence of the Newtonian view is that the parts of space – i.e. points – possess intrinsic identity. Now, the standard reading of Leibniz on space commits him to the outright denial of Newton's claim: space does *not* exist prior to, or over and above, physical bodies *in any sense*; the parts of space not only lack intrinsic identity but aren't even

properly thought of as locations within a substantival container. This is the essence of what has come to be known as “relationism”. Earman puts the claim this way: “spatiotemporal relations among bodies... are direct; that is, they are not parasitic on relations among a substratum of space points that underlie bodies” (1989, 12). On the standard reading, Leibniz's positive claim about space emerges from the negative claim in that space is simply the order of bodies, and nothing more, and would not exist without bodies.

Now, as I've said, I'm proposing that Leibniz's *actual* conception of space becomes clear when viewed through the lens of spacetime structuralism, and that there's a good deal of evidence that he was actually a proto- spacetime structuralist himself. As background for this interpretation, we need to recall the views of the spacetime structuralist. Broadly speaking, spacetime structuralism is an instance of a more general view in the philosophy of science called *ontic structural realism*, which is roughly the idea that, in Esfeld's and Lam's words, “there are objects, but instead of being characterized by intrinsic properties, all there is to [them] are the relations in which they stand” (2008, 31). The view amounts to the claim that the relational complexes described by fundamental physics fully individuate the relata that they contain; these relata include things like electrons and spacetime points. Wuthrich summarizes the view (without advocating it) in a recent paper: “The objects... do not have any intrinsic properties but *only relational ones*. So what is really there... is a network of relations among objects that do not possess any intrinsic properties but are purely defined by their 'place' in [a relational structure]” (2009, 1042). One can also distinguish, as Wuthrich does, two broad variants of the view: one according to which objects and relations are

ontologically on a par with each other, and another according to which what's fundamentally real is just the set of relations, and objects are only thought of as somehow emerging from those relations. This distinction will become important in my discussion of Leibniz's view.

The spacetime structuralist applies some version of ontic structural realism to the case of general relativity. The individuals in the domain of general relativity – the individuals participating in the theory's relational complexes – are the points of the spacetime manifold, which is the basic object on which fields are defined. For the spacetime structuralist, then, these points have no intrinsic properties or intrinsic identity, in accordance with ontic structural realism. Now, for the *moderate* spacetime structuralist, who adopts the view that neither objects nor relations are ontologically prior, there *are* fundamentally real spacetime points, but they are only individuated relationally, by the metric field and other key structural features of general relativity. In short, "there undoubtedly are space-time points that fulfill the function of objects[,] [b]ut instead of these objects having intrinsic properties, all there is to them is the relations in which they stand" (Esfeld and Lam 2008, 34). For a more radical structuralist, who applies the "relations only" version of ontic structural realism to the case of general relativity, there won't be anything like fundamentally real spacetime points; spacetime points will be purely emergent features of GR's relational complexes, which carry all the fundamental reality we can ascribe to the spacetime manifold. Crucially, both kinds of spacetime structuralist will emphatically deny that spacetime is purely relational, lacking anything over and above or prior to the relations between bodies. The nature of space lies between the substantival and relational extremes: it's *structural*, in the sense either that points

are real, existent individuals lacking identity independently of the relational complexes into which they enter, or the sense that points are not fundamentally real but emerge from something else that *is*, namely the relational complexes described by general relativity.

3. Leibniz's Anticipation of Spacetime Structuralism. With the structuralist view on the table, I can now launch my investigation of Leibniz, with two initial points of caution: first, showing that Leibniz was the progenitor of spacetime structuralism will necessarily involve a fair bit of interpretation and extrapolation, due to the obvious chasm between the physics of his day and the modern understanding of space and time as a unified whole described by general relativity. What I'm trying to show is that Leibniz holds a view that *in the vocabulary of his day* looks very similar to what today's spacetime structuralists say in *their* vocabulary. Second, the question of the relationship between Leibniz's ontology and his theory of phenomenal space is one of the most vexed in all of Leibniz scholarship. For the purposes of this paper, I will bracket this issue, though I think its resolution is ultimately relevant to the accuracy of the reading I advocate here. The goal of this paper is to motivate a new reading of Leibniz's theory of space taken on its own terms; I think that a serious investigation of the *Correspondence*, with these caveats in mind, will strongly suggest that my reading is correct.

Let's first look at a passage from Leibniz's third letter to Clarke, where he formulates perhaps his most famous definition of space:

> As for my own opinion, I have said more than once that I hold space to be something purely relative... I hold it to be an order of coexistences... For space denotes, in

> terms of possibility, an order of things that exist at the same time, considered as existing together, without entering into their particular manners of existing. And when many things are seen together, one consciously perceives this order of things among themselves. (2000, 14)

This passage is undoubtedly one of the sources of the canonical reading – Leibniz directly states that space is "purely relative". We ought to construe this remark, though, in light of what he says next: space is an *order* of things that exist at the same time, an order that has nothing to do with the "particular manners of existing" of its constituents. This feature of the definition is crucial; it already indicates that Leibniz thinks there's more to space than "direct" relations between bodies. It indicates, in other words, that relations between bodies are *not* direct, and *are* parasitic on something more fundamental. So even in his supposedly canonically relationist definition of space, we see hints of a more complex view. I also want to draw attention to the modal language he uses here: the spatial order has something to do with *possibility,* though the connection is unclear. I will make it more explicit soon, as it's one point on which I read Leibniz differently from the way Belot does.

Leibniz's first definition looks extremely suggestive. And what it suggests, other passages in the correspondence clarify. In his fourth letter, in response to Clarke's pleas to refine his view of space, he elaborates the view in an almost explicitly structuralist manner. I reproduce the passage in full here:

> The author contends that space does not depend on the situation of bodies. I answer: it is true, it does not depend on such or such a situation of bodies, but *it is that order*

> *which renders bodies capable of being situated, and by which they have a situation among themselves when they exist together*, as time is that order with respect to their successive position. But if there were no creatures, space and time would be only in the ideas of God. (2000, 27, emphasis mine)

Earlier, Clarke had challenged the idea that space depends on the particular arrangement of bodies; here Leibniz restates his view in light of the challenge, revealing that space in fact *does not* depend on the arrangement of bodies. He almost explicitly says that there's an underlying order, and that this underlying order itself *is* space. Space is the order that "renders bodies capable of being situated": Leibniz seems to think that there's some kind of ontologically prior relational complex, and that by virtue of taking certain places in this structure, bodies get their particular "situations". At this point we should note that the English word "situation" is a literal rendering of the Latin word "*situs*", and the concept of *situs* plays a crucial role in Leibniz's conception of space. In the *Metaphysical Foundations of Mathematics*, Leibniz defines *situs* as "mode of coexistence" and defines motion as "change of *situs* (1969, 667-668). *Situs*, in other words, is a relational property that bodies acquire by virtue of their particular place in the spatial order. Each body has a unique *situs* at any given time, given its place in the spatial order at that time; but the order that confers *situs* on bodies does not depend on the arrangement of bodies. Instead, the order *underlies* and *makes possible* the arrangement of bodies by specifying a unique but purely relational property at each place in the structure.

But what are we to make of the remark that "if there were no creatures, space and

time would be only in the ideas of God?" One might take this remark to imply that space actually *does* depend on the arrangement of bodies after all, or that Leibniz is just being inconsistent. To see that neither is the case, first recall the modal language that Leibniz uses in his first definition of space. The modal element of Leibniz's view, to my mind, connects at a fundamental level with his conception of God. To motivate the connection, consider these remarks from the *Monadology*:

> Now, since there is an infinity of possible universes in God's ideas, and since only one of them can exist, there must be a sufficient reason for God's choice, a reason which determines him toward one thing rather than another... And this is the cause of the existence of the best, which wisdom makes known to God, which his goodness makes him choose, and which his power makes him produce. (1989, 220)

On Leibniz's view of God, the latter conceives of all the possible universes and actualizes the best one. That the one he actualizes is the *best one* constitutes a "sufficient reason" for the choice to actualize it, in accordance with Leibniz's familiar dictum that there must be a sufficient reason for every event. With this view on the table, the remark about space in the mind of God makes much more sense, revealing a deep connection between space and God's creation of the world. It looks something like this: all of the possible universes exist in God's mind; the set of all possible universes includes the set of all possible spatial orders; when God actualizes the best possible universe, he also actualizes the best possible spatial order. Now, if there "were no creatures", God wouldn't yet have actualized anything; Leibniz thinks the actual world is the best possible world, and the actual world includes various and sundry

creatures. So space, considered in an abstract sense, independently of the actual spatial order, is an infinite set of *possible* structures in the mind of God.

Thus, one potentially confusing aspect of Leibniz's view turns out to be consistent with what I see as his proto-structuralism. It's not that if there were no creatures, there would be no space *because space is nothing over and above relations between bodies*; it's rather that if there were no creatures, there would be no world in the first place: by hypothesis, our world is the best possible world, and it certainly contains many creatures. And if there's no world, there's certainly no space. It seems, then, that we've cleared an important hurdle to reconstructing Leibniz's view in the way that I think it ought to be reconstructed.

We encounter another potential obstacle in a passage from his fifth letter, a passage in which he seems to propound a view at odds with what we've seen so far. Here are the relevant remarks:

> I do not say that space is an order or situation which makes things capable of being situated; that would be nonsense... I do not say, therefore, that space is an order or situation, but an order of situations, or (an order) according to which situations are disposed, and that abstract space is that order of situations when they are conceived as being possible. (2000, 61)

Leibniz here responds to Clarke's objection to the second definition of space, which I've just discussed at length. The first thing to notice is that Leibniz seems to deny directly the view of space advanced in that second definition, even seemingly declaring the earlier view to be nonsense! If this were the case, then interpretive integrity would demand that I relax my

structuralist reading. But we need to look at the way Clarke phrases his objection; in doing so, we see that he misreads Leibniz's second definition, and that Leibniz's response in this new passage is aimed at the misreading.

In his fourth reply, Clarke had objected thus: “I do not understand the meaning of these words: 'an order (or situation) which makes bodies capable of being situated'. It seems to me to amount to this: that situation is the cause of situation” (2000, 34). Notice that he *does not* object to the coherence of saying that an underlying order (structure) confers *situs* on the bodies that participate in it. He only objects to the coherence of claiming that an underlying *situation* confers *situs* on individual bodies: he thinks that it's incoherent to say that *situs* confers *situs*. Now, this claim would clearly be incoherent, but Leibniz never makes it. To see this, look back to the second definition cited above: Clarke simply inserts the parenthesis in his objection, and the parenthesis is what generates the objection in the first place. What this passage actually does, to my mind, is to reinforce the structuralist reading that I'm advocating. Leibniz agrees that *situs* can't confer *situs*, on pain of incoherence. But he never denies the claim that he had *actually made* in the second definition: the claim that an underlying spatial order is responsible for conferring *situs* on individual bodies. And in this new passage, he still holds that space is an underlying order: it's the order “according to which situations are disposed”. This remark, along with the second definition, indicates that Leibniz thinks of the spatial order as ontologically prior to the notion of *situs*: recall his assertion that space does not depend on the particular relations among bodies.

4. Spacetime Structuralism or Modal Relationism? At this point, it's hard to escape reading Leibniz as committed to space being prior to relations among bodies, in the sense that there's a deeper relational complex underwriting the latter. We've seen that *situs* is conferred upon bodies by an order that's prior to them and does not depend on them; bodies only acquire their modes of coexistence with each other by occupying places in this order. But we now might want to ask what this order really amounts to; I think I've established that it has something to do with prior spatial relations, but recently Gordon Belot has suggested that it involves a different kind of prior thing, though something that still makes Leibniz ultimately a relationist. A brief investigation and criticism of Belot's reading will help clarify my own position.

Belot argues that Leibniz holds a view close to Belot's own "modal relationism", in the sense that Leibniz "employ[s] a notion of geometric possibility in giving content to claims about the structure of space" (2011, 173). For Belot, there are two kinds of relationists. "Conservative" relationists "identify the geometry of space with material geometry" and "give truth conditions for claims about spatial structure that differ from those of substantivalists only in quantifying over material points rather than points of space" (2011, 3). In other words, there's nothing to space prior to the relations between chunks of matter; the geometry of existent matter is the geometry of space. Relations between bodies, consequently, are direct. "Modal" relationists, by contrast, deny the identification of spatial points with material points, instead employing a kind of geometric modality, such that claims about the ultimate structure of space are about what geometric relations could *possibly* be

instantiated by *any* set of material points. For these relationists, in other words, the relations between material bodies are no longer direct, but what they're parasitic on is a kind of modal structure, rather than a set of real parts or points of physical space. The truth conditions for claims about the structure of space, then, come from the facts about geometric possibility. For example, to say that space is *finite* is to say that "there is some number N such that it is *impossible* for material points to be located more than N units away from one another"; to say that space is *infinite* is to say that there is no such number (2011, 4). And the truth of the claim that space is finite (or infinite) depends on whether there is (or is not) such a number.

Belot thinks that Leibniz holds something like the latter view, and the argument for this interpretation revolves around two claims: first, that Leibniz is clearly *not* a *conservative* relationist, since a careful reading of his remarks about space indicates that he thinks the structure of space is prior to the structure described by the actual relations between material bodies. It should be clear that I fully agree with Belot about this. Secondly, though, Belot makes the *positive* claim that the relevant texts (including some of the same passages in the *Correspondence* on which I'm relying) support the reading that the underlying structure of Leibnizian space is modal: it's an order of geometric possibility rather than any kind of prior physical order. One way to think about this is to consider the question whether Leibniz thinks "that space can profitably be thought of as composed of geometrically related parts"; Belot answers in the negative, claims that this makes Leibniz "some sort of relationist", and then argues for a modal reading of Leibniz's relationism (2011, 173). By way of illustrating *my* reading: I agree that Leibniz denies the "geometrically related parts" view, but I do not agree

that this denial makes Leibniz *any* kind of relationist; I think his view of space involves grounding the relations between material bodies on something more than a set of modal constraints on geometric relations.

The following argument will illustrate the difference between my reading and Belot's, and will also illustrate the superiority of my reading. In addition to thinking that Leibniz is a modal relationist, Belot thinks that Leibniz is committed to the structure of space being *necessary*, or the same in all possible worlds. In any possible world, for Leibniz, space is three-dimensional and Euclidean. Now, if the structure of space is the same in all possible worlds *and* is to be understood as nothing more than a network of *possible* geometric relations, then in Leibnizian terms, space must be uncreated. In other words, it must exist only in God's mind. But we've canvassed some good reasons to deny that space only exists in God's mind: this is what I take the remarks about possibility in the *Correspondence* to be getting at. In the actual world, there *is* a spatial order; this order is one of the things God actualized when he created the actual world. So Leibniz seems to think that in the actual world, space does *not* only exist in God's mind. But equally, we have good reason to deny, with Belot, that space is just a consequence of relations between bodies. So it looks like Leibniz is neither a conservative relationist nor a modal relationist.

For Leibniz, there's a sense in which *modal* relationism, when combined with the view that the structure of space is necessary, has to collapse into *conservative* relationism, since there will be nothing in the created world prior to the relations between bodies on the former combination of views. But again, Leibniz is not a conservative relationist – he thinks

that *in the created world*, the structure of space is prior to the the structure of material relations. Space *is* part of the created world after all – it doesn't only exist in God's mind – *and* space is prior to the relations between bodies. At the same time, space doesn't consist of points that have intrinsic identity; instead, space is an *order* that confers a specific property – namely, *situs* – upon bodies *in* the order, by virtue of *where* they are in the order at a particular time. This view bears a striking resemblance to spacetime structuralism.

I can now finally address the question of what the created spatial order really amounts to: is it, as the moderate structuralist thinks, a collection of fundamental relations between equally fundamental points, but such that the points have no individuality or properties except those which the relations confer upon them? Or is it, as the more radical structuralist thinks, ultimately *just* a collection of relations? Leibniz's emphatic denial, in the *Correspondence* and elsewhere, that space has anything like actual parts leads me to conclude that he conceives of the underlying spatial order as something like the more radical alternative. It's the relations that are fundamental; out of them emerges the notion of *situs*, and out of this notion in turn emerges the notion of relations between material bodies. Space only has points, or parts, in a derivative sense: fundamentally, space is an order that allows us to talk about the locations of bodies, their relative positions, and the like. Another revealing set of remarks from the *Correspondence* bolsters the suggestion that Leibniz thought of ontologically basic relations as perfectly coherent and as fundamental in his theory of space:

> As for the objection that space and time are quantities, or rather things endowed with quantity, and that situation and order are not so, I answer that order also has its

> quantity: there is in it that which goes before and that which follows; there is distance or interval. Relative things have their quantity as well as absolute ones... And therefore though time and space consist in relations, still they have their quantity. (2000, 50)

This passage, in conjunction with the other passages I've examined, suggests that Leibniz thinks of the spatial order as ultimately a set of *distance relations* that are prior to and make possible the distance relations between material bodies. Crucially, this is very similar to the situation in modern spacetime structuralism: structuralists commonly take the *metric field* to be the fundamental determinant of the structure of spacetime, though other fields play important roles; and the metric field is precisely that field which encodes spatiotemporal distance relations within the spacetime manifold.

5. Does Leibniz's Ontology Allow for a Created Spatial Order? I will conclude by noting my awareness of an issue that my reading raises in connection with Leibniz's metaphysics. I said earlier that I would bracket the problem of the relationship between Leibniz's theory of space, taken on its own terms, and his deeper metaphysical commitments, but I cannot entirely avoid it, because a tension may arise between the two in asserting that Leibniz thinks spatial relations are part of the created world. It is widely accepted that Leibniz thinks relations have only a mental, or ideal, kind of reality. Though the precise meaning of this thesis is disputed, it does imply that the spatial order, on my reading, must be ideal *and* created. The only way this is possible, in Leibnizian terms, is if the spatial order ultimately

depends on the perceptions of individual substances, or monads. One might think that this commits Leibniz to an ultimate denial of the reality of the spatial order, making the structuralist reading pointless, unless we can show that dependence on the perceptions of monads does not imply unreality for Leibniz. I believe such a solution is forthcoming in terms of the mutual coordination of the perceptions of every monad in a world. The spatial order's dependence on monadic perceptions doesn't make it “unreal” in any robust sense, for every monad's series of perceptions is coordinated with that of every other monad so as to make all the monads perceive the same publicly accessible universe – which includes the spatial order – from its point of view. In this sense, the spatial order is just as objectively real as the monads themselves, and makes possible the arrangement of bodies that each monad perceives within that order. This reading is especially plausible when we consider that the basic individuating features of Leibniz's monads are just their perceptions; any order that depends on their perceptions will only be “ideal” in a very restricted sense. It would take another paper, one devoted to Leibniz's ontology of substance, to work out these issues fully; but I believe the potential conflict can be resolved, and that the evidence I've examined in the body of this paper strongly suggests that it's worth resolving.

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WORD COUNT: 4997